

Early management of diabetic ketoacidosis (DKA) in children

adapted from NICE NG18 (updated 2023) and BSPED Guideline for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis (2024)

Recognition

History of polyuria, polydipsia and weight loss.
May have confusion, abdominal pain and hyperventilation.

- Blood glucose $> 11 \text{ mmol L}^{-1}$
- pH < 7.3
- Blood bicarbonate $< 15 \text{ mmol L}^{-1}$
- Ketones: blood beta-hydroxybutyrate $> 3 \text{ mmol L}^{-1}$ or urine ketonuria ++ and above

Note: Usually not vomiting, acidotic or drowsy unless more than 5% dehydrated.

Severity of DKA and degree of dehydration

Mild: 5% dehydration	Venous pH below 7.3 or serum Bicarbonate $< 15 \text{ mmol L}^{-1}$
Moderate: 5% dehydration	Venous pH below 7.2 or Bicarbonate $< 10 \text{ mmol L}^{-1}$
Severe: 10% dehydration	Venous pH < 7.1 or Bicarbonate $< 5 \text{ mmol L}^{-1}$

Management

Resuscitation

A Ensure airway patency, insert NG tube if reduced conscious level or vomiting to decrease gastric distension.

B High flow oxygen via a face mask with reservoir bag + titrate to oxygen saturations 94-98% (for children with shock); avoid intubation unless respiratory arrest or respiratory failure when anaesthetic assistance is urgently required.

C Establish IV access, take venous bloods (pH, PaCO_2 , bicarbonate, sodium, potassium, urea, creatinine, beta-hydroxybutyrate levels, glucose), monitor ECG, identify shock.

- **Dehydrated but not in shock:**
Give a fluid bolus 10 mL kg^{-1} of balanced isotonic crystalloid or 0.9% sodium chloride over 30 min (discuss with senior paediatrician before giving a second bolus)
- **In shock:** Give a fluid bolus 10 mL kg^{-1} of balanced isotonic crystalloid or 0.9% sodium chloride over 5-10 min and re-assess; repeat to a maximum of 40 mL kg^{-1} ; inform PICU if shock persists and consider inotropes.

D Seek and identify signs and symptoms of raised intracranial pressure – headache, confusion, irritability, posturing, falling GCS, rising BP with bradycardia. Treat with 3% sodium chloride, seek PICU advice and call an anaesthetist. Consider CT brain to determine the cause.

E Consider sepsis if fever, hypothermia, hypotension, lactic acidosis, refractory acidosis.

IV fluids and insulin

For children with dehydration, nausea and vomiting: Calculate fluid requirements (FR) for each child.

Aim: to correct fluid deficit over 48 h.

FR = Maintenance fluids for 48 h + fluid deficit.

Subtract 10 mL kg^{-1} from fluid requirement for children who did not present with shock.

Do not subtract resuscitation fluid volumes from fluid requirements for children who presented in shock.

Isotonic balanced crystalloids or 0.9% sodium chloride initial fluid of choice – add potassium once passing urine and serum potassium is in normal range (usually $< 5.5 \text{ mmol L}^{-1}$); add 5% dextrose to fluid when glucose less than 14 mmol L^{-1} .

1-2 h after intravenous fluids commenced, start insulin infusion at $0.05\text{--}0.1 \text{ units kg}^{-1} \text{ h}^{-1}$ ($0.05 \text{ units kg}^{-1} \text{ h}^{-1}$ for children < 5 years old recommended).

Monitor serum potassium and treat hypokalaemia.

Do not give intravenous bicarbonate to correct acidosis.

Observations

Strict fluid balance.

Hourly capillary blood gas and blood glucose measurements.

Capillary blood ketone levels 1-2 h (ideally point of care testing).

Initially two-hourly U+E's.

Hourly BP, HR, RR, temperature, continuous ECG monitoring.

Hourly assessment of level of consciousness.

Half hourly neuro observations including level of consciousness in children with severe DKA and children < 2 years old.

Urgently escalate symptoms of headache, bradycardia, changes in level of consciousness or changes in ECG (ST and T wave changes may indicate hypokalaemia).

Fluid deficit (mL) = % dehydration x weight (kg) x 10

Fluid requirement (FR) over 48 h for a 10 kg child
= maintenance requirement for 48 h + (fluid deficit – initial fluid given) (if no signs of shock)

Note: max FR allowance for 5% dehydration = 3750 mL, 10% dehydration = 7500 mL.

Example: 5% dehydrated, no shock at presentation, given 10 mL kg^{-1} 0.9% saline
= $(4 \times 10 \times 48) + (5 \times 10 \times 10) - (10 \times 10)$
= $1920 + 500 - 100$
= $2320 \text{ mL over 48 h}$
= 48 mL h^{-1}

Maintenance fluids calculation

First 10 kg of body weight	$4 \text{ mL kg}^{-1} \text{ h}^{-1}$
For second 10 kg of body weight (11-20 kg)	$2 \text{ mL kg}^{-1} \text{ h}^{-1}$
For each kg of body weight above 20 kg (up to max of 75 kg)	$1 \text{ mL kg}^{-1} \text{ h}^{-1}$